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ABSTRACT

Noting the increased attention being given to the communication needs of specific professional groups, this paper concentrates upon the needs of engineers and engineering students. The first section of the paper provides a general discussion of the communication needs of practicing engineers and technicians and of the ways in which these needs have traditionally been met. The section serves as a rationale for the development of courses for engineers that concentrate on spoken communication. The second section describes the development of one course, which includes both oral and written communication, that was specifically structured for students in an engineering curriculum. The final section reports on a limited survey of 65 speech communication departments, which was designed to gather information about the amount of attention being given to the area of technical communication in the discipline. (FL)

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Developing a Broad Based Communication Course for Engineers

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As we are entering a new decade, scholars in the field of Speech Communication are engaging in an examination and assessment of how the discipline is meeting the needs of students with a wide variety of professional orientations. One area which may be particularly worthy of such attention, both to the special needs of the students and to how those needs may be met, is the communication of engineers and other related technical fields. This paper is an effort in that direction. The paper is divided into three parts.

The first section provides a general discussion of the communication needs of practicing engineers and technicians. Also included in this part is a discussion of the ways in which these needs have traditionally been met. The first section is, in effect, an attempt to develop a rationale for the development of courses for engineers which concentrate on spoken communication.

The second part of the paper describes the development of one course specifically structured for students in an engineering curriculum. The course includes both oral and written communication and is presently offered at the author's institution.

The final portion reports the results of a limited survey of Speech Communication departments. This brief survey was designed to gather some impression of how much attention is currently being given to the area of Technical Communication across the discipline. Specifically, the instrument asked selected departments if they offered specialized courses in the area of technical communication, sections of broader courses which treated

technical communication, specific content areas covered in these courses or units, and the potential for development of such courses.

Part One: The Need For Technical Communication

It would appear that the last several years have brought increased attention to the communication needs of specific professional groups. New texts in the area of Business and Professional Communication abound, as even a brief perusal of publishers ads in the convention program will attest. At the author's two recent institutions, Business and Professional Communication courses have had constant growth.

Even greater specialization has emerged. The subfield of Health Communication now commands a separate division of the International Communication Association. Another specific area to emerge, though modestly, has been the area of Technical Communication or Communication for Engineers and Technicians. Much of the attention in this area has not been from within the discipline of Speech Communication, but this specialization calls for our attention. At the author's institution, the College of Engineering and Applied Sciences has shown steady growth over the last several years. This year alone, the freshman class increased by 20% and the College has been forced to limit enrollments for the first time. As a consequence there has been a greater demand placed upon the Communication department to meet the needs of these students. We are constantly in the process of

investigating the specific needs of our "clients" and how we may address those needs. Many other departments may be faced with the same task.

While it is very possible that both basic speech communication or more specialized Business and Professional courses may provide substantial benefit to technical students, it is nonetheless worthwhile to ask whether more specialized courses are necessary. Do the communication needs of these students differ significantly from those of other students? Are our current courses specifically addressing those needs and are they acceptable to Engineering schools as vital parts of their curricula?

As the sophistication of the Applied Sciences increases there is evidence, also, of increased individual specialization and increased interdependence among specialties when solving the complex problems of technology (Rosenbloom & Wolek, 1970). Simultaneously, engineers are increasingly held accountable by the public for their proposed actions. Specialized engineers, thus, face great need and great dificulty in describing their concepts and proposals to other specialists and to the public. This public may not only lack technical sophistication, but may also resist proposals from their sense of "future shock." The engineer must also be able to express ideas to management who may also lack high levels of technical sophistication. The engineer must communicate information which is, in its "raw" state virtually incomprehensible to interested others.

This communication must be highly persuasive in many cases and may frequently be delivered to somewhat hostile audiences. As an instance, in the County of Milwaukee, engineers employed by the sewer district find themselves spending large amounts of time and effort both explaining and advocating proposed improvements to the public; improvements which will cost billions of dollars and substantially raise taxes in the county.

In many ways, this type of communication is called for on the part of many other professions and could therefore be treated as part of the more general courses currently offered by many departments. I believe, however, that the inherent nature of the topic of professional communication for engineers calls for, at least, specific training and practice, and perhaps even special techniques. A course for engineers may be desirable if for no other reason than to provide focused attention on the communication of technical material. There are, however, other reasons for such a course.

The need for specialized communication training for engineers has already been recognized and is frequently met through courses in technical writing. Again, one need only inquire of publishers about books in the area of technical communication to discover a wide array of texts in Technical Writing (e.g. Houp & Pearsall, 1980; Weisman, 1980, 1975; Mills & Walter, 1978; Pickett & Laster, 1980) and few, if any, recent texts devoted to spoken technical communication. To be sure, many of the writing texts contain a chapter on public speaking or

oral reports such as technical briefings. These units are, I believe insufficient for the real-life needs of engineers. The need for writing skills has been accepted, but the need for oral skills has not.

As has been noted by many others (See DiSalvo, 1980 for a summary) technicians and engineers, as do others in organizational contexts, spend large amounts of their time and efforts engaged in oral communication. In fact, there is additional evidence to suggest that the spoken mode is even more vital for engineers than may currently be recognized. Capacities for oral expression and reception appear to be critical for job performance and, to a degree, for personal success.

Research by Waldhart(1973) suggests that the large majority of technical reports in the Engineering literature are authored by academically affiliated engineers. These engineers represent a minority of their field.Waldhart notes that the typical product of an engineer employed in industry is some tangible object or process, not a report. This does not negate, entirely, the importance of written skills for most engineers. Certainly, many reports are generated for in-house use, not for publication. However, the restricted focus of technical communication as a written phenomenon may represent an academic bias not extant in the larger professional area. Many technical organizations, though perhaps out of frustration, employ specialists to produce technical reports.

The need for oral skills exists not only in addition to,

but perhaps above written skills in the technical organization. This need is evidenced by several sources. As long ago as 1962, the Engineering College Administrative Council and the Relations with Industries Division of the American Society for Engineering Education surveyed engineers and discovered that of the top ten subject areas selected as one in which the engineers felt a need for more education, five were communication related (Journal of Engineering Ed. 1965). Specifically, these needs involved oral communication. The paper presented today by Drs. Jounson and Johnson shows that this need still exists. The orientation of Dean Cannon reflects this realization. Research by Erickson (1972) indicates how important oral skills are as a function of time spent.Huegli and Tschirgi (1974) identified key oral skills which were vital to the success of entry level business and engineering graduates.

Perhaps even more revealing of the importance for engineers of spoken communication are the results of research into the processes of the diffusion of technical innovation and of technological problem solving. Rosenbloom and Wolek (1970) estimated that in upwards of 70% of the applications in industry of scientific innovations, the source of information about the innovation was personal contact. Allen (1970, p. 91) notes that even this personal contact is often ineffective because, "the average technologist cannot communicate effectively with outsiders" to the organization. Technologists, typically, do not read large amounts of research reports and do not effectively incorporate ideas from outside the organization. These problems lead to severe

lags in the application of breakthroughs; the peak period of first implementation of breakthrough appeared, in one study, to fall between twentyand twenty five years after discovery (Sherwin, 1966;1967).

Allen (1970;1967;1966) and Marquis and Allen (1966) have shown that, in the absence of effective communication skills on the part of most technologists, a key role has developed in technological organizations: the technological gatekeeper. It is through this person that new information enters the organization. This person is generally better integrated into the formal and informal networks of the field, can define these inputs for colleagues, and is generally better on a number of job performance criteria. When the gatekeeper is used as the source of input to the organization there is a marked imporvement in the quality of implementation. Clearly, from their research, a person with strong oral skills is critical to the functioning of the organization. Additionally, these skills may contribute to individual success.

Allen's research also emphasizes the importance of liaisons in the organization; those members of the technical organization who link the various divisions together through spoken communication. Simply, without persons who can effectively employ the spoken mode, the organization suffers.

Tompkins (1977) description of the NASA communication system suggests the critical nature of both oral and written skills in NASA's successes. While the written reports might identify the need for consultation across divisions, the oral

provided the means through which the problems were rectified.

From all of the above studies two prime conclusions may be derived: 1) Engineers need to know how to communicate through both the spoken and the written modes 2) To be effective, engineers must have some understanding of the communication structure of technological organizations.

While, I think, the need for speech communication training is made clear in the research, it is far less clear whether non-specialized courses may meet the needs. It would appear that they could do so if they had sufficient flexibility to : 1) allow sufficient practice in the communication of technical information both formally and informally. 2) Recognize and attend to the unique patterns of communication in technological organizations. 3) Use cases and examples of communication from the realm of the engineer's experience, not just a management perspective. To be sure, many engineers become, or are, managers, but training and teaching in this area alone will not be sufficient.

The greatest obstacle to the implementation of coursework in oral communication may not lie in the strength of the above types of arguments, but in the political realities of institutions. As noted earlier, there may be an academic bias toward writing which will be hard to overcome. Certainly, given the typical academic setting, engineering instructors are more likely to observe the benefits of coursework in technical writing than in spoken communication. Instructors see more written work as reports than oral reports.(At the author's institution there

greatest recognition of the students increased abilities in technical writing and in group cooperation. There are few opportunities for assessment of improvement of oral capacities).

In the crowded curricula of Engineering schools, there may be little leeway for two courses in communication arts; one oral and one written. Besides increasing required hours for the student, the increased hours also fall to another budgetary unit in many university structures.

The only possibility for support of a course in spoken communication for engineers may be if that course also entails training in written communication. This is, of course what happens in Technical Writing courses which have a brief unit on oral reports. This approach is not sufficient for the student. It is my belief that if the only way that communication may be taught is with one course then the prime focus must be on the spoken mode. While the incorporation of writing may seem onerous to many, and certainly falls outside our disciplinary purview as currently defined (Kibler & Barker, 1967), we may face the equally unattractive alternative of ignoring clear needs on the part of students while abdicating a part of them to other disciplines. The second part of the paper describes some ways in which the two modalities may be combined in one course. This course has a primary focus on the speech communication of the students, but also satisfies the needs of the College of Engineering.

Part Two: A Broad-Based Course in Communication For Engineers

The author's institution has, for several years, offered a course, Communication for Engineers, which encompasses both spoken and written communication. The course is required for most students in the College of Engineering and Applied Sciences. Enrollment now totals around 400 students each year. This course was developed and evolved through the efforts of many of my colleagues and predecessors. The following description is a reflection of these past inputs and of current plans.

The teaching of a course which covers a broad array of modes and contexts necessitates approaches which integrate. This course has been designed to focus specifically on concepts and skills which generalize across contexts. Obviously, this is not always possible or even desirable, but where a choice must be made about what particulars to emphasize in a given area, that choice is usually governed by whether the concepts generalize in some way or represent critical differences.

General concepts and terms applicable to the study of communication are introduced, applied to spoken communication for specific purposes then extended to other contexts and modes. As an instance, the concept of receiver orientations applies across all spoken contexts and is equally valuable for written communication. When this concept is presented, then, it is tied to the variety of contexts in which it applies. This application is later particularized for the context. We consistently try to avoid approaching each setting, purpose, or mode as a separate

entity to be focused upon until mastered with following contexts treated in similar isolation.

The development processes for both written and oral technical reports are parallel through many stages. Thus, both forms are treated together. For our oral persuasive, or analytic, speeches we require a problem-solution organizational pattern. This same approach has been reported and justified by Fitch (1980). This same pattern is one of the widely accepted organizational patterns for analytic written reports. We also emphasize this approach as one of several ways to structure the communication of a problem solving group. Obviously, there are many other ways to structure each of these contexts, but it would be somewhat unreasonable to expect the students to master all of these approaches in an introductory course. Morover, the emphasis of different organizational strategies in various settings would deny the student any opportunity for repetition and correction in subsequent exercises.

The selection of the problem-solution organizational strategy has taken on increased importance to us as enrollment pressures have had to be absorbed, in part, through increased numbers of students in each section. As a consequence, we have been forced to drop one round of speeches from our course; the formal technical briefing. Unless we are able to find additional classroom space, which is unlikely, so that we can create a more modular approach (See Wolvin & Wolvin, 1977), we will have to live with less formal speaking. The problem-solution organization for the analytic speech in fact forces the student to place a technical briefing within the

larger speech. Thus, we do not lose this valuable skill completely. In place of the technical briefing we have more time for the development of introductions, analogy and metaphor development, and for informal impromptu briefing and listening exercises. We hope also to be able to increase our unit on informational interviewing; a unit which is typically an integral part of a Business & Professional Course. We have had to sacrifice this unit in the past, but believe it to be one of the critical skills for technologists.

Another example of incorporation of generalizable concepts is our treatment of group communication. Here we focus particularly on factors which not only exist in small groups, but also in the larger organizational sphere. Networks, climate, roles are shown to apply across these contexts through analysis of the students group behaviors and through cases about organizations. Thus, the role of gatekeeper can be identified in the small group and in a technical organization. We are working on ways to structure our group projects so that they require interaction among the groups, as would be characteristic of an organizational system. The group project is designed as a problem for which the students must find a cooperative solution. The pattern of their interaction repeats the structure of their oral presentation earlier in the course and is, in turn, repeated in their written report. The group is also required to present an oral symposium of their findings.

As mentioned above, we spend some time on the development of metaphors and analogies. This form has been highly successful in helping the students find ways to communicate complex technical information .(we caution the students that analogies always abstract the concepts and may not be appropriate, particularly where great precision is necessary. They are invaluable for presentations to the general public). The use of analogies as a presentational device will also help, hopefully, the development of general mental and specific problem solving capacities which are vital for engineers.

The use of visual aids is discussed along with the use of graphics. These tools are also invaluable as a means of transmitting material to audiences. Aids are required for all formal presentations. Since all of of our students will take subsequent courses in graphic design we do not concentrate as heavily on graphic development skills, rather on an understanding of their function. In this case we also make a strong differentiation between the style of graphics and visual aids.

A key concept that is presented throughout the course is a perspective on interactions, across settings, as containing some specific components: introductions, bodies, and conclusions. This is done through the concentric conceptualizations offered by Knapp (1978) for interpersonal interaction. We try to get the students to recognize the importance of structuring not only speeches and reports with these components, but also how they are critical to interviews, the growth and development of groups, and in creating and sustaining dyadic relationships in the

organization.

A final note must be added on the importance of effective training of instructors for this course. For myself, there was an immediate need for retooling in technical writing. There are many resources for this. Some general texts in the area have already been identified above. In addition, Harty (1980) provides an excellent bibliography of sources in the area.

A second problem was to build a repertoire of examples and cases which have relevance to engineers. No single source can do this better than personal contact with practicing engineers. It has been well worth the cost of many rounds of beers to sustain some conversations with engineers about communication in their organizations. The sources cited throughout this paper also provide many concrete examples of communication in technological organizations.

Teaching Assistants also need solid training for this course. I am fortunate to have second year graduate students for this course. They are generally better prepared for the scope of the content. They have also, in our case, gone through a planned, regular development of their teaching skills during their first year. This is continued throughout the year they teach the engineers. Material to be read is provided the preceding summer. A weeklong orientation/training workshop is provided prior to the semester. This training involves course content, discussion management, evaluation strategies, problem management and simulations of classroom activities. This training is continued throughout

with formal weekly meetings and workshops, observation, videotaping and informal discussion. By the end of the year, T.A.'s are providing important insights for the development of the course. The effectiveness of the course is almost entirely dependent upon the skills and commitment of the T.A.'s. They must be able to cope with the individual components and to perceive the integrative strategies.

Assignments:

As noted above, the course is constantly evolving. The assignments below represent both the old and tried as well as some innovations to be incorporated next time around.

Exams: Two mulitple choice exams. Exams are analyzed for item effectiveness.

Formal Oral Analytic Report: The student is required to attempt to persuade the audience to accept some form of technical innovation. The speech should address a position which is not currently accepted by the general public and must recognize and treat opposing solutions to the problem. The problem-solution organizational strategy must be employed. The first part of the speech is, then, a technical briefing on the problem area. Analogies must be incorporated as well as effective visual aids. The audience asks questions about the presentation and may challenge the conclusions briefly.

Written Technical Report: Students are assigned to work groups early in the semester. These groups are used for a variety of exercises. Their primary task, however, is to develop a written

technical report on an assigned problem area. Because students are at the beginning of their technical training, the exercise is designed not so much to develop or exhibit technical expertise as a capacity to manage the communication. We are not qualified to evaluate the technical validity, only the communicative effectiveness (if that). Evidence of group effort and cooperation is critical. Reports must follow prescribed organizational strategies, exhibit clarity of technical writing, have appropriate graphics and include critical elements such as letters of transmittal and abstracts.

Group Oral Symposium: The findings of the group project are presented to the class. Each member of the group must take a significant part in the presentation and discussion. Presentations must be extemporaneous and must incorporate appropriately adapted and utilized visual aids derived from the graphics in the report.

Additional Assignments: Several shorter assignments are made. Each student must write a formal business letter in which the student makes an appraisal of another student's oral presentation. These letters are graded on format and clarity, grammar, etc. and on insights into the process of public communication. Each student writes a memo describing his/her participation in the group project. Other memos are written for specific purposes throughout the course. Each student generates a series of analogies and, as time allows, presents these to the class for feedback. Similarly, students generate introductions which are

delivered, then written up for submission.

Texts: The search for the ideal text continues. At present we use two: Gary T. Hunt's Communication Skills in the Organization Englewood Cliffs, N.J.: Prentice Hall, 1980; Herman M. WEisman's Technical Report Writing Columbus,OH: Merrill, 1975. The latter text is an abridgement of a more comprehensive writing text. The condensed focus has been particularly satisfactory for our purposes. The Hunt text, while it has many advantages over some other Business and Professional texts, lacks the specificity of examples and cases needed in a course for engineers. Most of the text revolves around managerial communication.

Weekly Schedule:

Week #	Lecture Topic	Discussion Activity
1	Orientation/The Nature of Communication	Syllabus Distribution/ Class Introductions
2	The Communication Process: Concepts, Models,Contexts	Discussion of Concepts Organize groups
3	Analyzing the Context Recognizing the Receiver	General Discussion/ Developing Specific Purposes,Thesis sentence Audience analysis
4	Preparing Technical Reports	Outlining,organizing, Visual aids,graphics/ Developing Intro.'s
5	Analytic and Persuasive Strategies	Present Introductions Delivery factors (oral & written)
6	Communicating:Interpersonal Context	Response styles/ Analogy development
7	Listening	Analogies/ Listening
8	Interviewing	Midterm & processing Interviewing cases

Week#	Lecture	Discussion Activities
9	The Group Process	Groups/Oral reports
10	Group Problem solving	Oral Reports
11	Leadership	Oral Reports
12	Technical Writing	Oral reports/Groups
13	Comm. in Organizations	Cases/Roles/Networks
14	Comm. in the Technical Organization	Discussion,cases/ Group symposium
15	Communication: Other Contexts, Other Forms	Group Symposium
16	Review	Group Symposium/Review

Part Three: Comparison to Other Courses

An attempt was made to gather an impression of how much Speech Communication departments have committed to specialized courses for engineers or technicians. A brief questionnaire was developed to assess whether surveyed departments currently have a course which is specifically designed for these students, what content areas are covered in these courses, whether the departments offer units in technical communication as a part of more general offerings, and whether department anticipate development of courses in this area.

A total of sixty five departments were selected from the 1980 listing of departmental members of the Speech Communication Association. This obviously represents some restriction from all departments in the field. Only departments which were part of four year universities were selected; another paper in this program will discuss junior colleges and universities are more likely to have a population of technicians than colleges. A total of 43 institutions (66%) responded to the questionnaire.

Based upon the survey, it is apparent that the discipline has not yet made a universal attempt to fit courses to the specific population of technicians. Only eight departments (18.6% of those responding) indicated that they had a course designed specifically for engineers or other technicians. Of these eight, two courses were entitled Business and Professional, one Business and Professional and Technical, one Technical Communication, one Communication Practices in the Professions, one Technical and Professional Communication, and one was unlisted.

All of the above departments listed the content areas of their course. Seven of these courses contained units on technical briefing. Additionally, five courses contained units on interviewing, small group processes, group presentations, interpersonal communication, and organizational communication. Leadership, communication theory, persuasive speaking, and listening were listed in four of these course. Finally, six courses covered Graphics/visual aids, three covered diffusion of technical information, three listed technical writing, and two business correspondence.

No real surprises emerge from this listing. Obviously, the small number of responding institutions listing such course makes generalization impossible. All that may be said is that there are some courses out there and that they cover a wide array of content areas with particular convergence on the traditional tools of informative speaking. The inclusion of technical writing in three of the courses indicates that this may be an area worthy of more attention if we anticipate growth in this area; we may have to take on some responsibility for technical writing. To do so would seem to require greater attention to how writing may be integrated into a course which is primarilly focused toward speech communication.

A total of seven institutions indicated that there were units specifically designed for technicians within more general courses. These course were quite numerous, including Business and Professional Communication (here I assume that the respondents perceived these course as more business and less technical than those who listed the same title as a specific technical course)

Interviewing, Organizational Communication, Small Group Communication, and several others. Thus, a total of thirteen departments (there were two departments which listed both specific courses and units within other courses) indicated that they are, in some measure, addressing some coursework specifically toward the communication needs of technicians. Another six departments indicated that they could foresee development of courses in this area.

Since most of the respondents did not return a detailed syllabus or course description, it is dificult to compare the courses to the one described in this paper. Clearly, many other courses are not involved in teaching writing. Writing is not a component of the courses described by either Fitch (1980) or Wolvin & Wolvin (1977). There do not appear to be many other courses which provide inputs about the diffusion of technical information and innovation as is the case in our course. This material may, however, be implicit in the discussion of organizational communication or small group processes.

This paper has discussed the needs of engineers for various forms of communication, how those needs are met in one particular setting, and the extent to which others in the discipline have developed similar approaches. It is hoped that this material will both assist others in their development of courses in the area and foster discussion which will help us all to develop our understanding of the area of Technical Communication.

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